June 22 , 1926. 1,589,727

W. TRAVELL

SUSPENSION DEVICE

Filed March 24, 1921 2 Sheets-Sheet 1

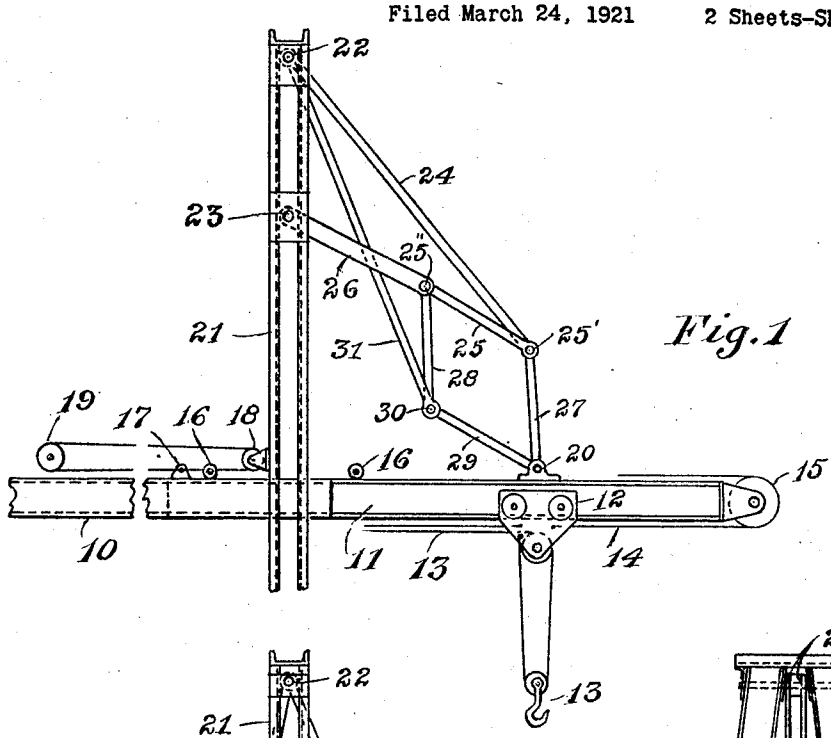


Fig. 1

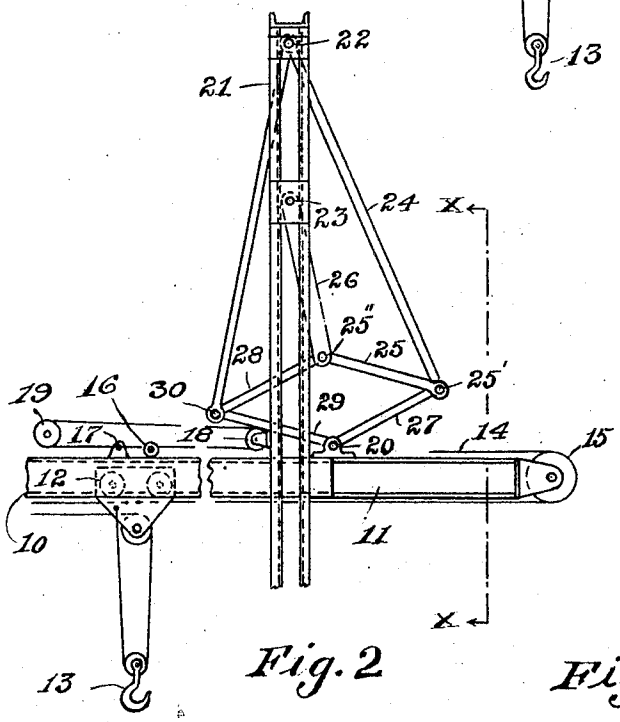


Fig. 2

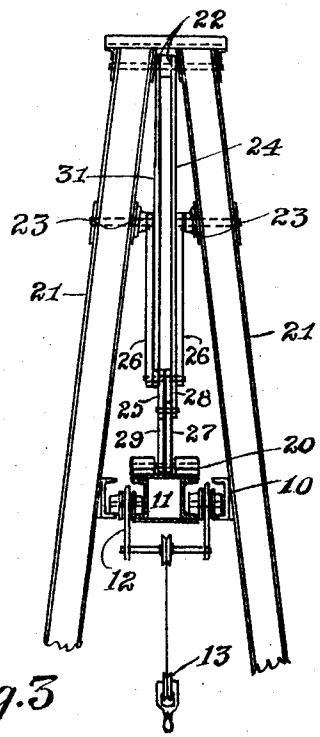


Fig. 3

Inventor
Warren Travell
by Mitchell, Chadwick & Kent
Attorneys

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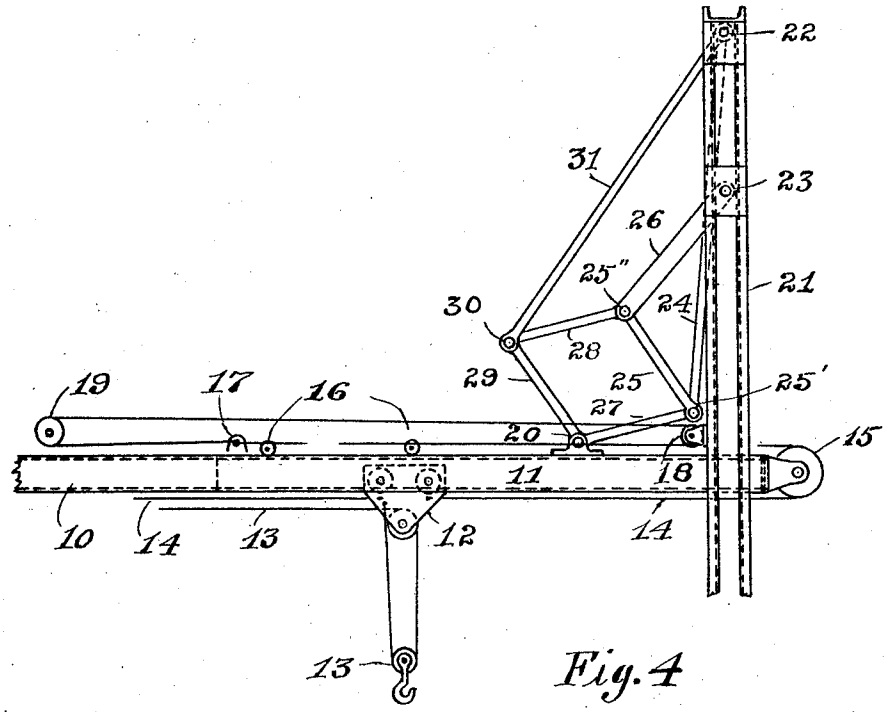


Fig. 4

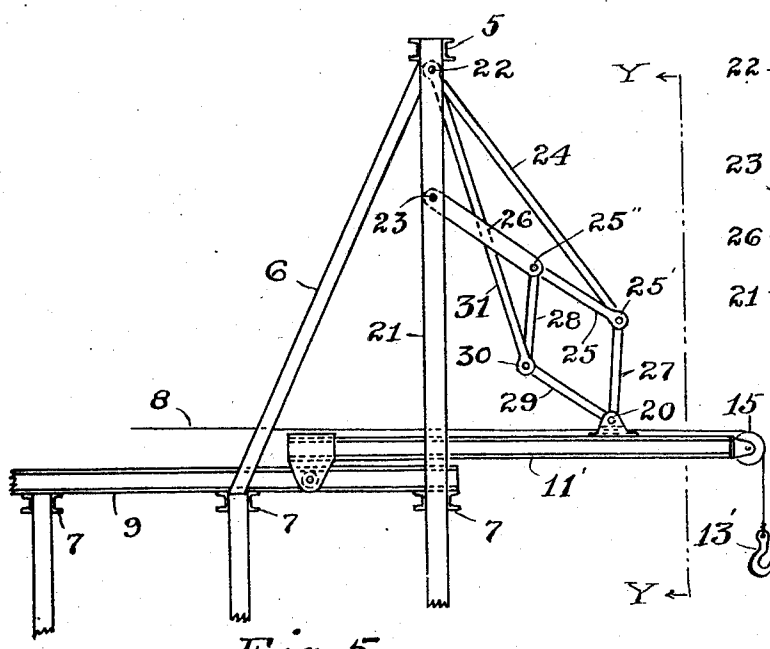


Fig. 5.

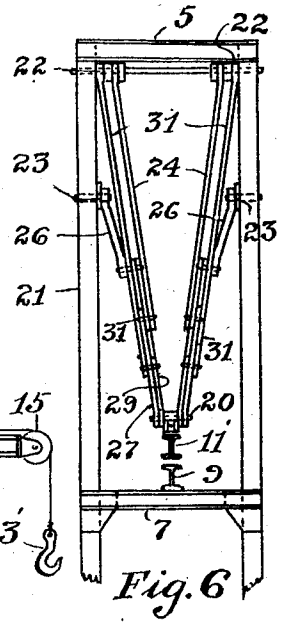


Fig. 6

Inventor
Warren Travell
by Mitchell, Chadwick & Kent
Attorneys

Patented June 22, 1926. 1,589,727

UNITED STATES PATENT OFFICE.

WARREN TRAVELL, OF NEW YORK, N. Y.

SUSPENSION DEVICE.

Application filed March 24, 1921. Serial No. 455,022.

This invention relates to improvements in material handling machinery. More particularly it relates to machinery in which a movable boom or the like extends to a variable distance from its point of support, moving in the direction of its own length when its position is changed. Ordinarily a stay rope would support its outer end, to be paid out or drawn in as the boom moves out or in, and the rate of paying out or in, relative to movement of the boom, would continually vary, being different when the boom is slightly projected from what it would be with the boom out near its limit. The purpose of the present invention is to provide means for supporting the outer end of the boom at all points of its extended position without paying in or out the support, and without the load causing a horizontal thrust backward along the boom. By eliminating such thrust, the boom requires but little power for being moved in and out, and for being held in any desired position, notwithstanding that its rear end may be resting on wheels or friction-reducing support of any sort. As herein illustrated, the invention is applied to a beam projecting and acting as an extensible boom in hoisting and transporting apparatus, in which a carriage carrying hoisting and holding apparatus may run upon the boom out from and back to the permanent way of which the boom is an extension. It is also illustrated as applied to such a boom having a fixed hoisting sheave at the extremity of the boom; and it may with advantage be applied in various other relations, as for example, in material handling apparatus in which the boom carries a belt conveyor, or a conveyor of other type, thus providing means for conveniently extending or retracting the conveyor to shift its point of operation. The objects of the invention are accomplished by providing a firm support such as a tower above the beam, on the upper part of which are two rigidly fixed points, at a certain distance apart vertically, from which extend members that constitute a part of a system of linkage which as a whole varies in length, as required by the variations in projection of the beam, but all of whose elements are of unchanging length, the end of the system being a depending supporting point which is capable of moving only in a line perpendicular to the straight line between said fixed points, this depending point being the outboard point of support for the boom. The said linkage comprises two ties depending pivotally from the upper and either a single or a double strut depending pivotally from the lower of the fixed points, together with four links of equal length, jointed together in a quadrilateral arrangement, the lower end of the strut being jointed to one corner of the quadrilateral and the lower ends of the two ties being jointed respectively to the two adjacent corners of the quadrilateral. The corner diagonally opposite the lower end of the strut is said depending point, being the point at which the boom is supported. The sides of this quadrilateral are illustrated as being equal in length. It is an essential condition that the said strut shall be equal in length to the vertical distance between the fixed points, in order that the depending and moving point of support shall move always in a line perpendicular to the vertical line joining said points as said tie and said strut swing around them. Under these conditions, stresses in the link motion are determined, and a load at the depending and moving point of support, such as weight of the boom and anything thereon, is carried through the linkage to the fixed points of support without causing any thrust horizontally along the boom whose outer end is hung at the said moving point of support. It follows that if the inner end of the boom be supported, as by wheels resting on and adapted to run on a fixed way constituting an inward extension of the line of the boom, a carriage and load may run on the boom and may tend to bend the boom without the weight thereof being resolved into any thrust along the boom tending to move the boom inward in the direction of its own length. In consequence, when moving such a boom in and out, as no stay rope of varying length is used, there would only be required a single drum and rope, the latter acting horizontally on the boom. The rope would simply pass around a fixed sheave, and have a point of attachment to the boom arranged to travel parallel with the travel of the boom. This makes it easy to run the boom in or out, reducing the required size of ropes and motor, as compared with practice hitherto, and in many cases permitting a hand winch to be used in place of the motor.

If the swinging strut and the distance be-

tween the fixed points are not equal in length, the line travelled by the depending point of support will be curved, producing a varying incline of the boom; and while this may in some cases be usable it is preferable that the stated condition of equality be observed for all ordinary cases.

In previous constructions having an endwise extensible boom it has been proposed to have a stay rope or tie running from the top of the tower down to the outer end of the boom. This has to change in length as the boom moves out or in, such variations ordinarily being accomplished by suitable attachment of the extension of the rope behind the tower, as by providing ropes and machinery for operating this stay rope and for properly varying its rate of extension or withdrawal. But as the depending tie which supports the outer end of the boom in the present invention does not vary in length, this invention results in another important improvement consisting in the elimination of the said ropes and machinery for operating and varying the rate of movement of the stay rope or depending tie which supports the outer end of the boom.

As the invention may be applied in various forms, the patent is not to be deemed limited to the specific forms herein set forth. It is intended that the patent shall cover, by suitable expression in the appended claims, whatever features of patentable novelty exist in the invention disclosed.

In the accompanying drawings:

Figures 1 and 2 are side elevations of an embodiment of the invention applied to a traversing hoist, respectively showing the link suspenders in positions they occupy when the boom is extended, and when partly retracted;

Figure 3 is a sectional view on line X—X of Figure 2;

Figure 4 is a side elevation showing the boom further retracted:

Figure 5 is a side elevation showing an intermediate position with a different form of boom and hoisting device; and

Figure 6 is a sectional view on line Y—Y of Figure 5.

Referring to Figures 1–3, 10 indicates a fixed way of any suitable sort and 11 a boom comprising a beam projecting therefrom on which a carriage 12 may run and carry a hook and tackle 13. A traverse rope 14 passing around a sheave 15 at the outboard end of the boom provides for drawing the carriage 12 back and forth on the boom. The whole may be arranged for the carriage to run on both the boom and the fixed way 10, one construction for doing which is shown in my United States Patent No. 1,305,631, of June 3, 1919. For moving the boom in and out to desired positions of operation, the present invention provides an improvement on the device shown in said patent. The inner end of the boom may be supported in any suitable way on flanged wheels 16 running on the top of the permanent way; and the boom may be moved on said wheels by a rope attached to its rear end, as at 17, and passing around a sheave 18 at the forward extremity of the permanent way and back to a sheave and driving drum 19 and thence to the point of attachment 17, to pull the boom in or out as desired. The invention is concerned with the support for the outer end of this boom, which consists of a suspending system of linkage attached to the boom at an eye 20 herein referred to as the depending moving point of support. The linkage which is attached to the boom at this point is supported from a tower represented in the drawings by the upright frame 21 which has two fixed points respectively marked 22 and 23 which may be assumed to be arranged in a vertical line braced with sufficient strength to hold the boom and its load and the linkage which depends from said points.

From the upper point 22, two ties 24 and 31 extend downward to the outer ends 25′ and 30 of links 25 and 28 respectively which are two adjacent links of a quadrilateral of four links 25, 27, 28, and 29 jointed together. At the point of connection 25″ of these two links 25 and 28, there is a strut 26 which rises to the lower fixed point 23 and is herein called the swinging strut. This strut may be a single member or, for symmetry and in order to obtain better distribution of stresses, it may be made double as shown in Figures 3 and 6. As represented in the drawings, the quadrilateral has its sides of equal length and all pivotally joined together, opposite sides of the quadrilateral being parallel at all times. The lower ends of links 27 and 29, jointedly connected at the point 20, form the depending point of support at which the weight of the boom 11 is carried. The general aspect of the system of linkage, therefore, is an equilateral parallelogram the upper corner of which is connected to the lower fixed point of support by a strut or pair of struts, the outer and inner corners are connected to the upper fixed point of support by ties and the lower corner forms the depending point of support. The lengths of the struts 26 are equal to the vertical distance between the rigid points of support. In a system of linkage thus constructed, the point 20 can move only in a line perpendicular to the vertical line passing through the fixed points 22 and 23, as can be demonstrated mathematically. Under these circumstances, any weight which is or may be suspended at the point 20 does not tend to move that point either in or out, if and when the line joining the points 22 and 23 is vertical, because the point 20 can move only in

a horizontal path, from which it follows that any weight imposed thereon is perpendicular to the line of its travel, and has no component acting in either direction along its line of travel, which is the line of movement of the boom.

Certain of the diverse positions which the apparatus may assume under these conditions are illustrated in the drawings, the boom being incidentally projected to varying degrees. The wheels 16 on which the inner end of the boom is supported in any suitable way may, therefore, be frictionless, theoretically, without the boom tending to shift its position when a load is lifted anywhere upon it. The lifting of such a load is usually most conveniently effected by a hook and tackle 13 operated from the region of the stationary way, as when the boom projects out over water. In such case, there is inevitably some inward pressure at the sheave on the carriage 12 which supports the tackle which may be sufficient to overcome the friction of the wheels 16; and so for practical purposes it is desirable to provide some sort of a fastening for the rope 17 which controls the movement of the boom, but this fastening need not be very strong; and the drum 19 which controls movement of the boom may be relatively small and may even be hand controlled, as by a winch.

As the invention has no particular relation to the uses for which the boom is applied, it is immaterial what sort of hoisting and transporting mechanism is employed upon it, if any. As indicating this, I have shown in Figure 5 a different form of mechanism, which is merely a hoist at the end of the boom but which may be used on the same boom therewith; but it will be observed that the boom thus supported might be used for any purpose such, for example, as to support the end of a belt conveyor, or the end of a projectable platform having no machinery.

In the claims the term "beam" is used in a broad sense as including any such structure supported at each end and subjected to bending stress by the weight thereon. It appears, however, that the moving point of support can perform the described function of outboard support regardless of whether it is associated with a beam.

And, moreover, although the invention has thus far for clearness and convenience been described as if the upper fixed point 22 were vertically over the lower fixed point 23, the plane of the linkage may in fact be inclined to the vertical. Any single set of the linkage would ordinarily be arranged in vertical plane; but by using two sets, rising in inclined planes from a single moving point 20 to separated fixed points 22 at the top of the tower, and to correspondingly separated points 23, the linkage prevents departure of the moving point in any direction from its prescribed rectilinear path, thus preventing side sway of the beam at all stages of extension in addition to sustaining it against gravity. Such an arrangement is represented in Figures 5 and 6.

Figures 1, 2, 4 and 5 being projections upon a vertical plane, are a substantially accurate representation of either a single set of the suspension linkage arranged in a vertical plane, or of a double set each of which is arranged in a plane inclined from the vertical as in Figure 5. Either arrangement of the suspender links is effective to support the outer end of the boom at all points of its horizontal travel and to eliminate rope handling and rate controlling mechanism therefor.

I claim as my invention:

1. The combination, with a beam movably supported at one end, of linkage depending from a fixed support and having a point which is restrained by the linkage from motion except in a straight line passing below said support; the other end of the beam being supported by said linkage at said point; and means other than said linkage to move the beam to and fro in the direction of its length.

2. The combination, with a beam movably supported at one end, of linkage depending from a fixed support and having a point which is restrained by the linkage from motion except in a straight line passing below said support; the other end of the beam being supported by said linkage at said point; there being means applied directly to the beam and through it indirectly to the said linkage to move the beam and linkage to and fro in the direction of the length of the beam; and the linkage being arranged for the motion of said point to be in the direction of the length of the beam.

3. The combination, with a beam supported at one end and means imparting to it motion in the direction of its own length, of linkage depending from fixed points of support in alignment, said linkage having a point restrained by the linkage from motion except in a line perpendicular to said alignment and below both of said fixed points of support; the other end of the beam being supported by said linkage at said restrained point; the said alignment being in a vertical plane, perpendicular to the beam, whereby the movement of the beam is maintained horizontal and the weight of the beam and any load carried thereby produces no thrust in the beam in the direction of movement of the beam.

4. The combination, with a beam movably supported at one end, and means to move the beam endwise, of a device supporting the other end, comprising two ties of equal

and unvarying length, a strut and a quadrilateral of links; the latter being jointed at one corner to the said beam and there supporting it, and being jointed at its opposite corner to the lower end of the strut, and being jointed to the two ties at the two corners intervening between the two first mentioned corners; the upper end of said strut being supported at a fixed pivot; and the two ties being suspended at a point fixed above and in a plane passing through said fixed pivot and the jointed point of support of the beam at a distance equal to the length of the strut.

5. A horizontally extensible device for handling material, including a beam and a support for one end thereof whereon the beam is movable horizontally in the direction of its length, combined with means for thus moving the beam, and means for supporting its other end, comprising a structure rising above the first mentioned support and having two fixed points of support, both in a vertical plane perpendicular to the beam, and one of them above the other; two ties and a strut depending pivotally from them respectively, the two ties being equal and of unvarying length and the strut being equal in length to the distance between said fixed points of support; and a quadrilateral of links jointed together, the four corners of which are pivotally connected to the strut, the two ties, and the beam respectively; whereby motion of said beam is maintained horizontal in the direction of its length by the linkage.

6. A support for moving material comprising means for holding two points fixed in position, the one above the other; two ties depending pivotally from the upper point and a double strut depending pivotally from the lower point, the two ties being of equal and unvarying length and each member of the double struts being equal in length to the distance between said fixed points; and a quadrilateral of links pivotally connected, having two upper sides whose adjacent ends are pivoted together to the lower end of the double strut, and whose separated ends are pivoted severally to the lower ends of the two ties; and having two other sides whose upper ends are pivoted to the two ties respectively and whose lower ends, pivoted together, constitute a point of support movable in a straight line perpendicular to and below the line joining said fixed points; combined with means whereby said point of support may sustain a load; and means for transmitting force horizontally to said point of support, thereby to move it and any load sustained thereon.

7. A rectilinearly movable support, comprising, in combination, means for holding a pair of horizontal supporting axes, fixed in position and perpendicular to the direction of said motion, the one above the other; two ties each composed of a pair of bars depending pivotally from the upper axis, the ties of each pair extending diverging in the general direction of said motion, and the point of support of one pair being separated at a distance from the point of support of the other pair on their common axis, with the pairs converging therefrom; two struts depending pivotally from the lower axis, their points of support being separated at a distance apart on their common axis, and these struts converging from their point of support and being of length equal to the distance between said fixed axes, when measured in projection on a vertical plane perpendicular to said fixed axes; and eight links, constituting two quadrilaterals side by side, each quadrilateral having its upper corner pivoted to one of the two struts, its two corners of middle height pivoted to the diverged ends of the ties in one of said pairs, and its lowest corner joined with the lowest corner of the other quadrilateral to form the point of support; whereby said point is supported in two directions against deviation from a rectilinear path.

8. The combination of a boom extensible and retractible in the direction of its own length and movably supported at its inner end; means for so extending and retracting the boom; a carriage travelling on said boom from which the load to be carried is suspended; means for moving the carriage along the boom; means for raising and lowering the load suspended from the carriage; and link suspenders depending from two fixed points of support and comprising two ties of equal and unvarying length, a strut equal in length to the distance between the said two points of support, and a quadrilateral of links having one side whose ends are pivoted to the strut and to one of the ties respectively, having a second side whose ends are pivoted to the strut and to the second tie respectively, having a third side whose ends are pivoted to one of the ties and to a point of the boom respectively, and having a fourth side whose ends are pivoted to the other tie and to said point of the boom respectively; thereby constituting a point of support for the outer end of the boom.

9. The combination of a boom extensible and retractible in the direction of its own length and movably supported at its inner end; means for so extending and retracting the boom; and a support for the outer end of the boom comprising link suspenders depending from two fixed points of support and comprising two ties of equal and unvarying length, a strut equal in length to the distance between the said two points of support, and a quadrilateral of links having one side whose ends are pivoted to the strut and

to one of the ties respectively, having a second side whose ends are pivoted to the strut and to the second tie respectively, having a third side whose ends are pivoted to one of the ties and to a point of the boom respectively, and having a fourth side whose ends are pivoted to the other tie and to said point of the boom respectively; thereby constituting a point of support for the outer end of the boom.

Signed at New York, New York, this 23rd day of March, 1921.

WARREN TRAVELL.